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ABSTRACT

This paper provides a concise statement of the current technology of quantitative analysis as applied to university decisionmaking. The author argues that quantitative decision analysis can be particularly relevant in situations involving stress, uncertainty, large amounts of resources, and institutional survival. The process of decision analysis is described. It begins with the identification of a set of operationally defined variables that characterize the components of the institution relevant to the decision under study. The set of functional relationships between the controllable variables and other attributes both inside and outside the institution are investigated. This provides a mathematical description of cause and effect and input and output. The operational articulation of the characteristics of an institution that results can provide a basic talking document for the resolution of conflict and the formulation of decisions. The current technology of decision analysis techniques and planning models is described. The paper concludes with a brief discussion of the motivation for decision analysis, and argues strongly for its increased use in academic settings. (Author)

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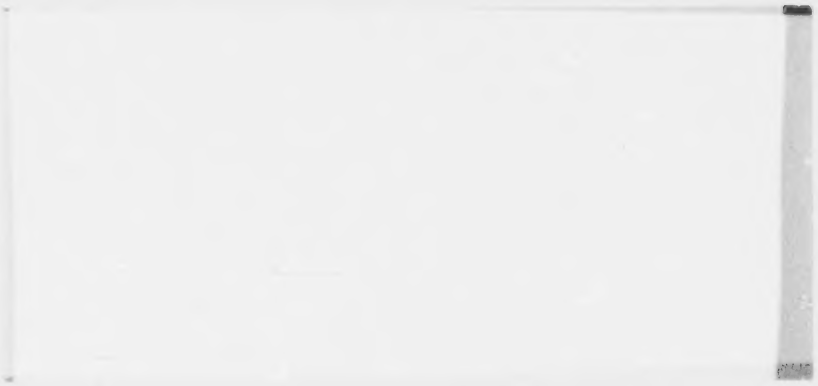

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EDUCATIONAL PLANNING AND DECISION MAKING: THE USE OF DECISION AND CONTROL ANALYSIS

George B. Weathersby

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PREFACE

This is one of a continuing series of reports of the Ford Foundation sponsored Research Program in University Administration at the University of California, Berkeley. The guiding purpose of this Program is to undertake quantitative research which will assist university administrators and other individuals seriously concerned with the management of university systems both to understand the basic functions of their complex systems and to utilize effectively the tools of modern management in the allocation of educational resources.

This paper was prepared as an address to the Association of Minnesota Colleges, May 1, 1970. Its purpose is to provide a concise statement both of the conceptual basis and of the current technology of quantitative analysis as applied to university decision making.

INTRODUCTION

When I listen to college presidents speak, both in public and in private they describe a life torn by political pressures, lashed by student unrest and starved by inadequate financial support. I ask college administrators how they cope with these countervailing pressures, with the mental, physical and fiscal turmoil which engulfs so many of our campuses, with the waning public moral and financial support which characterizes some of our state institutions, and I am regaled with tales of political intrigue, bargaining, and compromise. Furthermore, the accepted folk wisdom of today seems to be that quantitative analysis has virtually no role in the political realities and bureaucratic infighting associated with both the external acquisition of resources and the internal allocation of resources. I fundamentally disagree with this position, and I would like to persuade you that quantitative decision analysis can be particularly relevant in situations involving stress, uncertainty, large amounts of resources and institutional survival. Without being melodramatic, I seriously question whether educational institutions founded upon the principles of scholarly inquiry and quality education can long exist disdainful of their many constituencies, insensitive to their environment, and morally uncommitted in a time of massive, visible, social malaise. We can meet illegal, ethically unsupportable challenges to the physical integrity of our campuses with tear gas and billy clubs, but we need far sharper tools, far more responsive and responsible instruments to deal with justifiable challenges to our intellectual integrity. Decision analysis is one such tool; I urge that educational administrators understand it and use it. I should warn you that most new techniques die of entrepreneural oversell

and bureaucratic neglect. Decision analysis is no different.

One conceptual framework which I find useful in the systematic analysis of university planning and decision making is the process of resource acquisition and allocation. On the one hand, the allocation of an organization's scarce resources is the essence of its activities and the embodiment of its values and goals. Organizations move towards their desired objectives by marshalling men, equipment, consumables, and services into an institutionally acceptable plan of action. In this respect institutions of higher education are no different from other organizations. We allocate resources to training engineers because some of our constituencies value trained engineers. We allocate resources to agricultural research because some of our constituencies value the products of agricultural research. We are now allocating resources to ethnic studies and ecology because some of our constituencies desire it. In other words, the functional articulation of political, educational, and even radical rhetoric is found in the allocation of an institution's scarce resources.

On the other hand, the allocation of an organization's scarce resources is often the focus of conflict arising from the divergent values of different elements of its constituency (including students and faculty, blacks and whites, legislators and parents), from the political use of an institution (as in California and Massachusetts), from factual disagreements over the functioning of an institution (e.g., what does it really cost to introduce a new major field or to admit 200 additional art students?), from disagreements over and differing attitudes towards uncertainty (e.g., how much income can we count on from the uncertain return on our endowment, how will students respond to a new course in radical economics?),

and from a changing constituency with more people demanding more influence in the allocation of resources.

Therefore, we see that the allocation of an institution's scarce resources is both the vehicle through which values and objectives are articulated and by which they are pursued and also a major process through which conflicting goals and objectives can be resolved. Unfortunately, the actual compiling and controlling of budgets is often an autocratic, administrative task which does not explicitly or formally address the problems, objectives, or goals of an institution. This conceptualization of budgeting is a vestige of our attempts to be more "business-like," more "efficient." However, we have often overlooked a very important point. Businessmen both buy and sell all of their goods and services in an economic market which determines the relative value of each good or service as viewed by the entire trading community. This enables business to decentralize decision making, transmit values, and resolve conflicts by analyzing the expected monetary return of alternative resource allocations.

On the other hand, while institutions of higher education, like most other public or quasi-public agencies, must buy all of their inputs in the market place (faculty, personnel, supplies, services, and capital) they do not sell their outputs at all and, therefore, have no source of external explicit evaluation of their products. (What is the relative value of a B.A. in philosophy vis-a-vis an M.S. in physics or a dropout in art?) As a consequence, explicit values are rarely communicated between planners and managers, resource budgeting tends to be centralized or at least the flow of information is one way, and outputs are frequently redefined every time a department chairman or a dean wants something new.

I am convinced that there are better ways to allocate our scarce resources, communicate our relative values, and resolve our conflicts.

There are many mechanisms for allocating scarce resources including[1] bidding, bargaining, force, fraud, voting, and a price system. Economists have studied these problems for many years and a conclusion common both to socialist and to capitalist planners[2] is that a competitive pricing system is often the most effective and efficient allocation mechanism available. Decision analysis enables educational administrators to establish internally and explicitly a price system which would recognize many non-economic distributional and equity considerations and would facilitate, though not insure, the flow of information, the effective decentralization of decision making, the resolution of many conflicts and, as the result, the efficacious allocation of resources.

WHAT IS DECISION ANALYSIS?

Colleges and universities are very complex living organisms which both preserve the tortuously won and laboriously recorded history of man's past accomplishments and failures and provide the promise of whatever future mankind can anticipate. Such complicated human structures do not yield their secrets easily to naive statistical analysts, nor should they.

While some entrepreneurs offer to today's educational administrators global solutions in search of a problem, decision analysis[3] begins with a

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[1] Martin Shubik, "On Different Methods of Allocating Resources," RAND Report No. P-4161, July 1969.

[2] See Abba Lerner, Economics of Control, Macmillan, 1944; and Milton Friedman, Capitalism and Freedom, The University of Chicago Press, 1962.

[3] See Howard Raiffa, Decision Analysis, Addison-Wesley, 1968, for a complete discussion of decision analysis and utility theory.

decision maker, a college president, a chancellor, or a dean, facing a particularly vexing, volatile, or momentous decision. A decision analyst works with the administrator to circumscribe the perimeter of the problem and to map out the key features of the terrain. With this guidance, the analyst can perform the necessary quantitative investigations and report the findings to the administrator for his comment and reaction. An iterative dialogue than proceeds between the analyst and the administrator until the administrator feels comfortable with the indicated allocation of resources and policy choices.

One of the key steps in this process is the identification of a set of operationally defined variables which characterize the components of the institution relevant to the decision under study. For example, a student admissions officer might consider high school grade point averages, SAT scores, desired major field, degree of financial need, intensity of personal recommendations, previous family relationship with the institution, and the student's race to be essential variables which characterize the applicants for the purposes of admission decisions. However, the housing officer might only consider the number of entering and continuing students of each sex in making his decisions about residential facilities. In other words, the institution looks very different from the perspectives of various decision makers and relevant decision analyses and information systems should reflect these differences. Thinking through the appropriate set of variables which characterize the institution for a particular administrator is possibly the most essential prerequisite for relevant decision analysis and, concomitantly, it is one of the major contributions of rational analysis to our understanding of what colleges are and how they operate.

In general, an administrator can only control a small number of the total set of relevant variables while the remaining characteristics are determined either outside or inside the system. For example, the institution can control the number of new students admitted and the amount and distribution of financial aid offered, but it cannot control the actual number of students who enroll in September, their family characteristics, the military draft, or a myriad of other factors which influence the students' decisions. In addition, the institution's resource allocations are expressed by the values prescribed for the control variables. The objectives, goals, and philosophical values of an institution are embodied in the numerical values chosen for the control variables. An administrator exercises his leadership, directs his organization, and focuses its efforts through the judicious choice of his control variables.

Moreover, the role of analysis extends beyond the identification of the characteristics relevant to a particular decision maker and the further identification of his controllable variables; the role of analysis includes the investigation of the relationship between the control variables at the disposal of the administrator and the other attributes determined both inside and outside the institution. For example, decision analysis might enable a graduate dean to relate academic success as measured by a student's completion of his doctoral program, which is an internal variable, to scholarship assistance provided, research and teaching assistantship available, and academic counseling, all of which may be institutionally controllable variables, and to the depth of undergraduate preparation, parental attitudes, the draft, and personal characteristics of the student, all of which are external characteristics. At this point the decision analyst should call upon the experience of current practitioners, the

insights of economics and sociology and the tools of statistics and econometrics first to formulate and then to estimate the functional relationships existent between these variables. This provides a mathematical description of cause and effect, of input and output, of action and reaction. In effect, this analysis provides a model of the social, economic, and physical dynamics of the decision maker's system. These models are often called production functions or simulation models[4] because they describe or simulate the effects produced by the chosen values of the control parameters on the internal variables.

Furthermore, the numerical values associated with these functional relationships enable a decision analyst to determine the degree of influence, the extent of managerial control available to the decision maker. The decision and control analysis of educational decision making is, to my knowledge, the only feasible approach currently available which enables administrators to assess analytically the controllability of their institution.[5] In other words, one of the by-products of a carefully constructed quantitative analysis is the numerical information necessary to determine the degree of manageability of the organization. In this context, a decision analyst can investigate the effects on managerial controllability of structural changes within the organization and simulate the relevant results of new academic policies, disciplinary procedures, faculty review and promotion regulation, and other operational modifications. A major advantage of this approach is that the simulation can be performed in advance of actual functional changes without committing either financial

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[4]George B. Weathersby, "The Development and Application of a University Cost Simulation Model," Office of Analytical Studies, University of California, Berkeley, June 1967.

[5]George B. Weathersby, "Mathematical Analysis for Public Sector Decision Problems," Discussion Paper #4, Ford Program for Research in University Administration, University of California, 1969.

resources or institutional prestige.

If an administrator learns, to his surprise, that he cannot fully control some components of his system, he should not despair for, indeed, he is in the good company of most public and many private administrators. However, an administrator responsible for a partially uncontrollable system should not choose specific numerical objectives or goals (such as 10% minority students or 12 Woodrow Wilson scholarships) because the major effect of structural uncontrollability is to render these specific goals elusive and their pursuit futile. This does not mean that the decision maker should resign his institution to random wandering; on the contrary, the administrator should still seek the best allocation of resources available (the highest minority participation rates or the most Woodrow Wilson scholarships), but this "best" will have to be defined without reference to specific objectives or targets.

Thus we observe an interplay, a dialogue, a two-way flow of information and guidance between administrator and analyst in a fiducial relationship. In this case, the results of the analyst's empirical analysis may modify the statement of the administrator's objectives and goals because they are operationally unachievable. In general, the values used in appraising the relative desirability of alternative resource allocations should emanate from the decision maker or should flow from the institution's constituencies through the decision maker. There are a number of admittedly imperfect techniques available[6] to assist the administrator in assessing his preferences in an analytic form which can be used directly in the decision analysis.

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[6] Howard Raiffa, op.cit.; and George B. Weathersby, "Preference Structures, Group Decision Making, and Linear Systems in Public Sector Decision Analysis," Discussion Paper #3, Ford Program for Research In University Administration, University of California, Berkeley, 1969.

Conceptually there is little difficulty in deriving an expression of a decision maker's preferences for the variety of outcomes or products of an allocation of resources within his institution. However, the derivation of acceptable institutional values often initiates far-ranging conflict within the organization. The lords of every academic fiefdom--department chairmen, research directors, librarians, administrators, student leaders--all press their own points of view and, in fact, it would be illogical for them to do otherwise.[7] Unfortunately, a college president has no assurance that the sum of all of these individual points of view is an academically coherent and politically supportable institutional posture. Far more frequent results are political power plays, personal alienation, deterioration of morale, and a loss of public confidence.

While decision analysis has no easy answers, and in practice there are none, it does offer several approaches and possibilities which *may* alleviate some of the conflict. The operational articulation of the characteristics of an institution can provide a basic talking document for the parties of a major dispute. There may be either pervasive agreement or violent discord on an issue as broad as "meaningful undergraduate education." However, when "undergraduate education" is decomposed into various skills, experiences, choice situations, proficiencies and other attributes, we can begin to identify and to isolate the areas of major conflict and to accept the prevailing values in areas of wide spread agreement. In the remaining areas of conflict, educational leaders can seek new, imaginative alternatives which are preferable to all of the interested parties (such as new colleges or work-study plans), conflicting

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[7] Mancur Olson, The Logic of Collective Action, Harvard, 1965.

groups can learn to coexist (as in experimental ungraded courses and separate Black Studies programs), or administrators can at least draw an unambiguous line of demarcation around the issues of conflict so that we may preserve as much as possible of the mutually accepted and treasured ethos of the institution.

Another possibility for the amelioration of conflict is the decentralization of decision making. The existence of an explicit value structure in the decision analytic approach enables administrators to relax their concentration on the inputs to the educational process and focus instead on the outputs of the institution. Individual students and faculty could then select institutions on the basis of specific goals served and rewarded by the institution (such as undergraduate liberal arts instruction or graduate instruction in the sciences). Resources could be allocated to a campus or an institution by a central administrator according to the degree to which they satisfy their own objectives and according to the relative value placed upon their overall objectives by the funding agency. This would enable, though not require, each institution to develop its own unique character, provide greater diversity in a system or a state, and reduce the scope of consensus required for a decision. All of these factors should lead to at least a partial resolution of conflicting goals, objectives, and values.

Other conflict resolution mechanisms exist in the decision analytic approach but the most important observation is that the quantitative articulation of an institution's resource allocation decision problems provides a structure, a framework for the communication of values and objectives, and for the decomposition of complex, convoluted problems into smaller, more manageable problems. Decision analysis provides a

vocabulary with which the various segments of an institution's constituency can explore their areas of agreement and seek resolution of their remaining differences. However, this analytical approach requires a favorable environment for nurture and development and that the protagonists learn how to operate together in this kind of framework.

ENVIRONMENT FOR ANALYSIS

As I have described it, decision analysis begins with an administrator facing an agonizing decision. He then turns to a trained decision analyst who works with him in the consideration of his problem and in the selection of his best allocation of resources and policy decisions. The productive functioning of this relationship depends in part upon the uncontrollable chemistry of human interaction, but it also depends upon the prevalent managerial climate, the degree and quality of shared information on values and objectives, and the availability of factual information on institutional characteristics.

While the interactive chemistry of two human beings is largely uncontrollable, the prevalent managerial climate within an institution is largely established by the president of that institution. I believe that wise, well-considered decisions require good analysis, good analysis requires competent, secure analysts, and good analysts require a supportive, open, honest, ethical environment. If an analyst knows that he will not be supported for correct but unpopular recommendations, his analysis will soon become popular if not correct and he will become useless both to himself and to his administrator. If an administrator has already made up his mind on an issue, he doesn't need a decision analyst, he needs a verbally facile public relations specialist who will write an *ex post facto*

justification for the decision. If an administrator does not share his true feelings and values with his decision analyst or if his decision analyst is too biased to assimilate these values properly, he will find the results of analysis irrelevant and his analyst both frustrated and ineffective.

The relationship of an administrator and a decision analyst should resemble the relationship between a man and his physician. Typically, you do not seek a physician's help unless your physical difficulties are either severe or are potentially severe. When discussing your problems with a physician it is to your advantage to describe your symptoms and feelings as accurately as possible and to accept your physician's diagnosis of your real problem. It is much the same way with decision analysis. You can ignore your physician, you can lie to your physician, you can disregard the advice of your physician, but your problems will not go away. It is much the same way with decision analysis. You can have a private family physician, you can deal only with specialists, you can seek and obtain conflicting advice but ultimately, you must choose which path to follow. It is much the same way with decision analysis. Your physician does not attempt to run your body for you, rather his objective is to insure that you are physically prepared to deal with the difficult and stressful situations which you face. A man's relationship with his physician should be one of mutual respect, trust, integrity, and confidence. The same relationship should exist between an administrator and a decision analyst.

In addition to a favorable managerial climate, careful analysis also requires factual and interpretative information describing the institution's characteristics. At this point, there is often confusion over the

distinction between data and information. Data is simply a group of facts or statistics while information is the synthesis of facts and statistics into a form which is relevant and meaningful to a particular administrator. Information gained from personal conversations, observation, and assessment is just as valid as information laboriously gathered from ten thousand observations. In fact, an administrator may have a great deal of information in the complete absence of any numerical data simply because he has carefully observed the functioning of his institution over an extended period of time. Decision analysis combines the information available from all existing sources and, as a by-product of the resource allocation analysis, it determines the most efficient amount of new information that the administrator should collect.

In other words, the careful application of decision analysis produces not only the "best" allocation of an institution's scarce resources but also the structure of the "best" management information system for the decision maker in question. A management information system is a structure which aggregates, displays, and transforms basic data into information relevant to one or more decision makers. In the framework I have presented, management information systems, like internal pricing schemes, administrative organization, and actual resource allocations, are a logical outcome of the careful, comprehensive, rigorous application of decision analysis. Although the computer programs and procedures may be developed centrally, a relevant management information system and every other product of decision analysis ultimately relates back to a specific human being responsible for a particular set of decisions.

Earlier I made a distinction between the processes of resource acquisition and resource allocation. Those administrators who have to

deal with legislatures, governors, foundations, and private donors on the one hand, and deans, faculty, students, and parents on the other, may feel that there is a strong dichotomy between the processes of resource acquisition and allocation. However, the resources allocated at one decision level are the resources acquired at a lower decision level. In other words, if we understand the nature and procedures of the resource allocation process at the state and federal levels of government and within private foundations, we perforce understand the nature and procedures of resource acquisition at the institutional level. Consequently, we have all of the conceptual tools needed to analyze and to understand both processes of resource acquisition and allocation and we have come full circle in our discussion.

CURRENT TECHNOLOGY OF DECISION ANALYSIS

The image of decision analysis I have portrayed may seem fanciful, naive, utopian, and infeasible. It may be fanciful, naive, and utopian, although I will argue that decision analysis is more realistic, comprehensive and relevant than any other currently available or foreseeable alternative. Furthermore, I contend that decision analysis is not only technically, economically, and computationally feasible but it is also bureaucratically, and organizationally feasible. While all the mathematical analysis that may be justified in a particular situation would not cover the back of the proverbial envelope, in many circumstances large scale mathematical models and computer programs are needed to deal with complex systems. This area has received particularly concentrated research and development during the past five years and we have developed

a significant collection of instruments and repertoire of experiences.

Resource Prediction Models

One of the earliest subjects of administrative research was the prediction of the resources required for the operation of an educational institution under a particular set of policies. Typically, these models predict the faculty, supporting staff, supplies, and capital facilities necessary to accommodate a particular number of students recognizing student instructional demands, faculty staffing and workload policies, nonacademic support relations, and other sponsored research and administrative policies. These institutional characteristics may be considered to be tautologically defined by the decision maker;[8] they may result from an econometric analysis of the functional relationships within an institution;[9] they may be described by a set of input-output relations;[10] or the dynamics of the institutional characteristics may be represented by a state space model.[11]

Basically, these models relate induced resources to decisions parameters. Currently, we have not constructed a model to relate resource

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[8]Richard W. Judy and Jack B. Levine, "A New Tool for Educational Administrators - Educational Efficiency Through Simulation Analysis," University of Toronto Press, 1965.

[9]George B. Weathersby, "The Development and Application of a University Cost Simulation Model," Office of Analytical Studies, University of California, 1967; and the WICHE RRPM-1 model currently under development.

[10]Laurence P. Nordell, "A Dynamic Input-Output Model of the California Educational System," Technical Report No. 25, Center for Research in Management Science, University of California, Berkeley, August 1967.

[11]Herman E. Koenig, et.al., "System Model for Management, Planning, and Resource Allocation in Institutions of Higher Education," Final Report, National Science Foundation C-518, Michigan State University, September 1968.

inputs to educational outputs; this is not because of inadequate technology but because of inadequate definition and characterization of outputs.

Student and Faculty Flow Models

Another area of considerable research interest has been the progression both of students through the educational system and of faculty through the academic structure. A number of Markovian models have been developed and applied to the prediction of student enrollments and the evolving rank distribution of faculty.[12] These simple models have been extended to include the values of the administrator or planner and sophisticated mathematical techniques have been used to solve these more realistic decision formulations.[13]

Student flow models can be combined with resource prediction models to estimate the institutional cost per degree awarded or other cost per student output measure. Furthermore, the effects of financial aid, employment, and other institutionally controllable variables can be included to enable decision makers to choose the appropriate level and distribution

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[12] J. Gani, "Formulae for Projecting Enrollments and Degrees Awarded in Universities," Journal of the Royal Statistical Society, Series A., 126.3, 1963; Robert M. Oliver, "Enrollment Models," Report No. 68-3, Ford Foundation Research Program in University Administration, University of California, Berkeley, 1968; David J. Bartholomew, "Mathematical Analysis of a Graded Manpower System," Paper P-3, Ford Foundation Research Program in University Administration, University of California, Berkeley, 1970; Robert M. Oliver, "An Equilibrium Model of Faculty Appointments, Promotions, and Quota Restrictions," Report No. 69-10, Ford Foundation Research Program in University Administration, University of California, Berkeley, 1969.

[13] Jonathan Halpern, "University Resource Planning: Bounds Induced by the Use of Ratios," Ford Foundation Research Program in University Administration, University of California, Berkeley, 1970; Stephen M. Rowe and George B. Weathersby, "A Control Theory Analysis of Faculty Structure, Promotion, and Hiring," Ford Foundation Research Program in University Administration, University of California, Berkeley, 1970 (forthcoming).

of student financial assistance. Meanwhile, faculty promotion and aging characteristics can be modeled in such a way that academic planners can choose a faculty hiring sequence that best meets their age or rank distributional goals.

Financial Management Models

A third area that has received the attention of both academic planners and managerial researchers is that of financial management. Some of these planning models are simply automated traditional accounting procedures focusing mainly on the financial aspects of institutional operations.[14] Other models recognize capital outlay decisions specifically and relate these decisions to student charges and other sources of financial support.[15] At least one model explicitly combines educational, physical plant, and financial considerations with the decision maker's values to determine the best interrelationship between operating decisions, capital outlay decisions, and financial investment decisions.[16]

Management Information Systems

Finally, an area which has generated considerable interest recently is that of management information systems. In the past five years a number of institutions have developed computer data systems tailored for their

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[14] Peat, Marwick and Mitchell's RAPID and CAP:SC.

[15] Stephen A. Hoenack and George B. Weathersby, "Student Charge Plans and Capital Outlay," Ford Foundation Program in University Administration, University of California, 1970 (forthcoming).

[16] Robert Ramy, Ford Foundation Research Program, University of California (forthcoming).

own administrative needs and patterned after their own organizational structure. In part, these developments merely automate traditional financial and business services, but in part they represent a fundamental rethinking of information flows and decisions. In a major national effort, the WICHE MIS project is developing both a general framework and an "esperanto" or language to facilitate inter-institutional flows of data in addition to a set of analytical tools to assist institutional decision analysis.

MOTIVATION FOR DECISION ANALYSIS

However, none of these quantitative tools or models addresses all of the problems confronting college presidents today and none of them address these pressing problems as thoroughly or as forcefully as I have argued decision analysis should. Why not? One reason is that analysis costs money and in the short run it costs more money than not doing analysis at all. In this context, we almost always prefer to repeat yesterday's mistakes than to avert tomorrow's disasters. Another reason is that educational administrators do not really know either what to expect and to demand from quantitative analysts or how to respond to the demands of their analysts; in other words, there does not exist the fiducial relationship which is so necessary. A third reason is that analysis runs counter to many long established academic traditions. Academia has about as many sacred cows as all of ancient India and traditional analysts face a similar number of untouchable subjects. Furthermore, current administrators surely feel threatened by these old concepts cloaked in new words and implemented on computers.

While these rationalizations exist for perfectly understandable reasons, today's problems of student unrest, increasing political pressures, flagging financial and moral support, and increasing environmental concern demand more than tired excuses based upon short sighted economy, inadequate awareness of administrators, and staid tradition. Personal ethics implore, public accountability requires, and the primitive sense of self-preservation demands a vigorous, positive, convincing response to these problems. To the best of my knowledge of both its strengths and weaknesses, decision analysis is the best framework for a vigorous, positive, and convincing response that conscientious administrators have at their disposal.

Have I painted too maudlin a picture of the capabilities of quantitative analysis? Have I described an ethereal dream sequestered somewhere beyond the horizon of some unchartered sea? No, I do not believe so. Although our analytical vessels are frail, I believe that they are seaworthy, and that our conceptual rigging is in order. Yet we remain transfixed to the continent of tradition, besieged in academia by turmoil, our ranks depleted by personal alienation and social dissatisfaction. When men of an earlier era faced these same problems, they sent forth explorers who ventured beyond the horizon in search of a more tenable site for a new settlement. We must do the same. When former beasts of burden and accustomed ways of life no longer served them well, our ancestors cast them aside. We must do the same. When individual resources were inadequate, sensitive and searching people banded together and collectively sought their basic goals. We must do the same.

We need to experiment carefully and yet creatively with new forms of education, new physical and social structures for institutions. We need to explore new modes of communication, new concepts of time and space,

leisure and work, self and community, new organizations of facts and information, concepts and disciplines, theories and applications. We need to develop new conceptualizations of students and of faculty, of institutional constituencies, of environmental design, of public moral posture.

These are our goals--not analysis for its own sake. The Pilgrims sought a new world and not a boat ride. However, their ship provided a means of conveyance from the old world to the new. It can be much the same way with decision analysis.

PUBLISHED REPORTS

68–3 Oliver, R. M., *Models for Predicting Gross Enrollments at the University of California.*

69–1 Marshall, K., and R. M. Oliver, *A Constant Work Model for Student Attendance and Enrollment.*

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